Configuring Frame Relay Services

Router Software Version 11.0
Site Manager Software Version 5.0

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Bay Networks

Bay Networks

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Contents

Configuring Frame Relay Services

About This Guide

Before You Begin xiii
Conventions xiv
Acronyms xv
Ordering Bay Networks Publications xvi

Technical Support and Online Services

Bay Networks Customer Service xviii
Bay Networks Information Services xix
World Wide Web xix
Customer Service FTP xix
Support Source CD xx
CompuServe xx
InfoFACTS xxi
How to Get Help xxi

Chapter 1
Starting Frame Relay

Preparing a Configuration File 1-1
Starting Frame Relay 1-1
Deleting Frame Relay from a Platform 1-2

Chapter 2
Frame Relay Overview

Frame Relay Packets 2-2
Management Protocols 2-4
Frame Processing 2-5
Frame Relay Service Records 2-5
Default Service Record 2-5

Multiple Service Records 2-6
Adding and Moving PVCs 2-6
Hybrid Mode 2-6
Using Hybrid Mode for Transparent Bridging 2-7
Source Routing 2-9
RFC 1490 2-9
Protocol Prioritization 2-9
Address Resolution 2-10
Data Compression over Frame Relay 2-11
Multiline 2-11
Traffic Distribution between Data Paths 2-12
Random Distribution 2-12
Address-based Distribution 2-13
Congestion Control 2-13
Configuring Synchronous Lines for Frame Relay 2-15
For More Information about Frame Relay 2-15

Chapter 3
Customizing Frame Relay

Using the MIB Object ID 3-1
Adding and Deleting Service Records 3-2
Adding and Deleting PVCs 3-2
Moving PVCs from One Service Record to Another 3-3
Configuring Hybrid Mode 3-3
Enabling Compression 3-4
Selecting a Management Type 3-4
Selecting Address Type and Length 3-5
Selecting a DLCI Address Type 3-5
Selecting Address Length 3-6
Monitoring the Connection 3-6
Enabling Multicast 3-7
Controlling Congestion 3-8
Grouping Service Records for Multiline 3-9
Deleting Frame Relay from the Router 3-9

Appendix A
Frame Relay Parameters

Interface Parameters A-1
Service Record Parameters A-8
Multiline Parameter A-12

Appendix B
Frame Relay Default Settings

Index

Figures

Figure 2-1. Frame Relay Network 2-1
Figure 2-2. Frame Relay Header, 2-Byte Format 2-3
Figure 2-3. Frame Relay Header, 3- and 4-Byte Formats 2-3
Figure 2-4. Conceptual Drawing of the DLCMI 2-4
Figure 2-5. Hybrid Mode Configuration, Non-Fully-Meshed Network 2-7
Figure 2-6. Example of a Bridged Network 2-8
Figure 2-7. Multiline Network 2-11
Figure 2-8. Detecting and Controlling Network Congestion 2-14

Tables

Table 2-1. How Protocols Handle Address Resolution 2-10
Table 2-2. Synchronous Line Parameters for Frame Relay 2-15
Table B-1. Frame Relay Interface Parameters 13
Table B-2. Frame Relay Service Record Parameters 14
Table B-3. Multiline Parameter 14

About This Guide

If you are responsible for configuring and managing Bay Networks™ routers or BNX platforms, read this guide to discover how to customize Bay Networks router software for Frame Relay.

Refer to this guide for

- Instructions for starting Frame Relay (Chapter 1)
- An overview of the Frame Relay protocol (Chapter 2)
- Instructions on editing the Frame Relay interface and service record parameters (Chapter 3)
- Parameter descriptions (Appendix A)

Before You Begin

Before using this guide, you must complete the following procedures. For a new router:

- Install the router (refer to the installation manual that came with your router).
- Connect the router to the network and create a pilot configuration file (refer to *Quick-Starting Routers and BNX Platforms*, *Connecting BayStack AN and ANH Systems to a Network*, or *Connecting ASN Routers and BNX Platforms to a Network)*.

Make sure you are running the latest version of Bay Networks Site Manager and router software. For instructions, refer to *Upgrading Routers from Version 7–10.xx to Version 11.0*.

Conventions

bold text	Indicates text that you need to enter, command names, and buttons in menu paths. Example: Enter **wfsm &**
	Example: Use the **dinfo** command.
	Example: ATM DXI > Interfaces > **PVCs** identifies the PVCs button in the window that appears when you select the Interfaces option from the ATM DXI menu.
brackets ([ ])	Indicate optional elements. You can choose none, one, or all of the options.
italic text	Indicates variable values in command syntax descriptions, new terms, file and directory names, and book titles.
quotation marks (“ ”)	Indicate the title of a chapter or section within a book.
`screen text`	Indicates data that appears on the screen. Example: `Set Bay Networks Trap Monitor Filters`
separator (>)	Separates menu and option names in instructions and internal pin-to-pin wire connections. Example: Protocols > AppleTalk identifies the AppleTalk option in the Protocols menu.
	Example: Pin 7 > 19 > 20
vertical line (|)	Indicates that you enter only one of the parts of the command. The vertical line separates choices. Do not type the vertical line when entering the command. Example: If the command syntax is
	show at routes | **nets**, you enter either **show at routes** or **show at nets**, but not both.

Acronyms

ANSI	American National Standards Institute
ARP	Address Resolution Protocol
ATM	Asynchronous Transfer Mode
BECN	Backward Explicit Congestion Notification
BOFL	Breath of Life (message)
CCITT	International Telegraph and Telephone Consultative Committee (now ITU-T)
C/R	Command/Response bit
CRC	Cyclic Redundancy Check
DCE	data communications equipment
DE	Discard Eligibility
DLCI	data link connection identifier
DLCMI	data link control management interface
DTE	data terminal equipment
EA	Extended Address Bit
FECN	Forward Explicit Congestion Notification
FTP	File Transfer Protocol
IP	Internet Protocol
IPX	Internet Packet Exchange
ISDN	Integrated Services Digital Network
ITU-T	International Telecommunications Union–Telecommunication Standardization Sector
LAN	local area network
LMI	Local Management Interface
MAC	media access control
PRI	Primary Rate Interface
PVC	permanent virtual circuit
TELNET	Telecommunication Network (protocol developed for DoD ARPANET)
VC	virtual circuit
URL	uniform resource locator
WAN	wide area network

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Sydney, Australia	(612) 9927-8800	(612) 9927-8811
Tokyo, Japan	(81) 3-5402-0180	(81) 3-5402-0173

Chapter 1
Starting Frame Relay

The quickest way to begin using Frame Relay on your network is to enable it with default values for all interface parameters and a default service record. The sections that follow describe this procedure.

Preparing a Configuration File

1. Create and save a configuration file that has at least one WAN interface.
2. Retrieve the configuration file in local, remote, or dynamic mode.
3. Specify router hardware if this is a local-mode configuration file.

Starting Frame Relay

To enable Frame Relay:

1. Select a link or net module connector that requires a WAN circuit.
2. Specify Frame Relay as the WAN protocol.

Site Manager Path: From the Protocols Window that appears after you select the link or net module, select Frame Relay. Click on OK.The Select Protocols window appears.

You have enabled Frame Relay. You can now enable the protocols you want to run on this interface.

Protocol prioritization is enabled automatically when you select Frame Relay. For detailed information on protocol prioritization, refer to *Configuring Traffic Filters and Protocol Prioritization.* Refer to the appropriate configuration guides for information on enabling the protocols you want to run on this interface.

For further information, refer to *Configuring Routers*.

Deleting Frame Relay from a Platform

To delete Frame Relay from *all* circuits on which it is currently configured, follow this path:

Site Manager Path: Configuration Manager > Protocols > Frame Relay > Delete Frame Relay. A window prompts: `Do you REALLY want to delete Frame Relay?` Click on OK. Site Manager returns you to the Configuration Manager window. Frame Relay is no longer operating on the platform.

Chapter 2
Frame Relay Overview

Frame Relay is a high-speed, packet-switching WAN protocol that connects geographically dispersed LANs. Frame Relay is usually offered by a public network provider; however, private organizations can acquire and manage their own Frame Relay networks as well.

Frame Relay is a connection-oriented protocol, which means that it relies on existing end-to-end paths between devices connected across the network. It implements these connections using *permanent virtual circuits (PVCs).*

A PVC is a logical path the network provides to connect two devices. This path between the source and destination point is a dedicated connection, so the PVC is always available to the connected devices. Since many PVCs can coexist, devices can share the bandwidth of the transmission line.

Figure 2-1 illustrates a Frame Relay network.

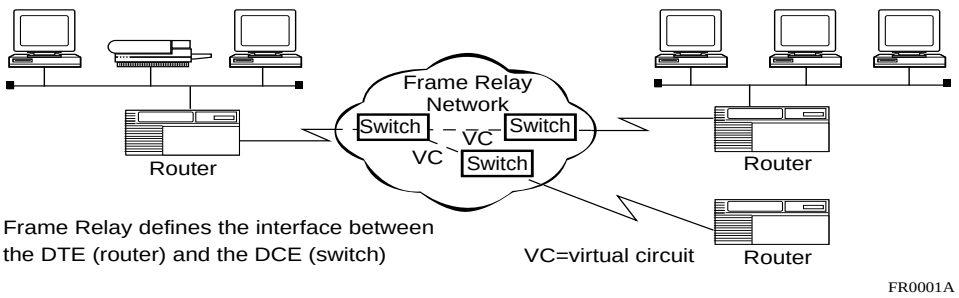

Figure 2-1. Frame Relay Network

Frame Relay assumes that networks use transmission lines with low error rates, such as digital transmission media. Consequently, Frame Relay provides only basic error detection with no error recovery. This minimizes the processing required for each packet, allowing Frame Relay networks to operate at higher speeds with fewer network delays.

Because Frame Relay performs only basic error checking, endstations running upper-layer protocols such as Internet Protocol (IP) are responsible for resending packets that did not transmit correctly the first time.

Frame Relay Packets

Figure 2-2 illustrates the structure of a Frame Relay packet. The packet's header field includes the following:

- Data link connection identifier (DLCI)

  The DLCI is the permanent virtual circuit (PVC) identification number. The Frame Relay network uses the DLCI to direct basic data flow.

- Command/Response bit (C/R)

  ITU-T (formerly CCITT) standards do not use this bit.

- Forward explicit congestion notification (FECN) and backward explicit congestion notification (BECN)

  The FECN and BECN indicate congestion on the network. See "Congestion Control" later in this chapter for information about how the Frame Relay software uses these bits.

- Discard eligibility (DE)

  The DE bit allows the router to mark specific frames as low priority (discard eligible) before transmitting them to the Frame Relay network.

- Extended address bit (EA)

  The EA bit signals whether the next byte is part of the address. This bit indicates the last byte of the DLCI.

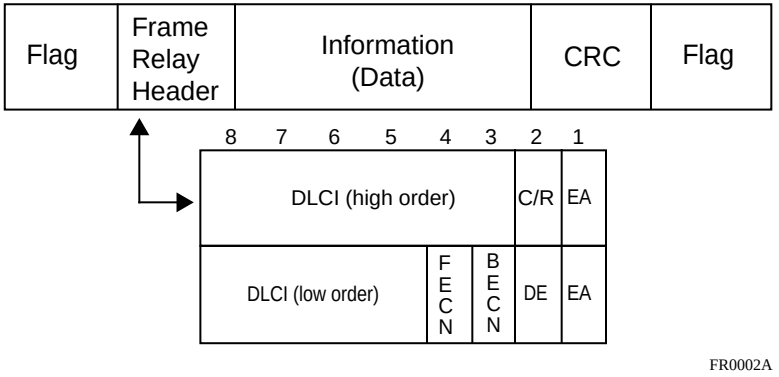

Figure 2-2. Frame Relay Header, 2-Byte Format

Figure 2-2 depicts the Frame Relay header as a 2-byte structure. Frame Relay can also format the header using 3 or 4 bytes, as shown in Figure 2-3. Note, however, that you must configure the Frame Relay interface on the router to use the same header length as the switched network to which it is connected.

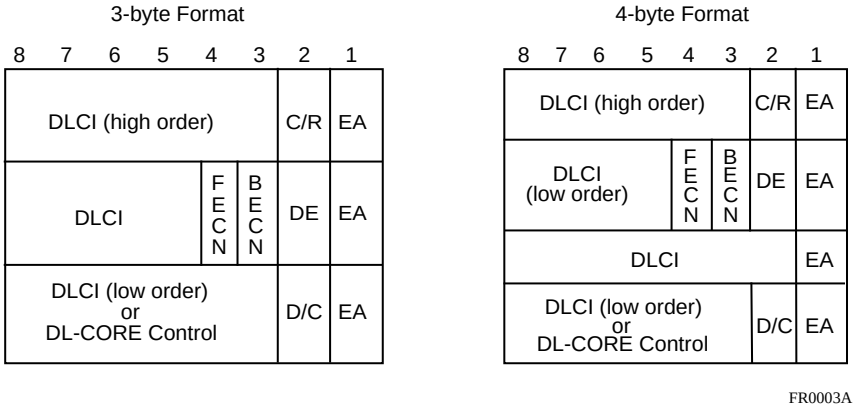

Figure 2-3. Frame Relay Header, 3- and 4-Byte Formats

Management Protocols

Frame Relay is an access protocol that runs between a router or data terminal equipment (DTE) and a switch or data communications equipment (DCE). The router and the switch use the Data Link Control Management Interface (DLCMI) to exchange information about the interface and the status of each PVC (Figure 2-4).

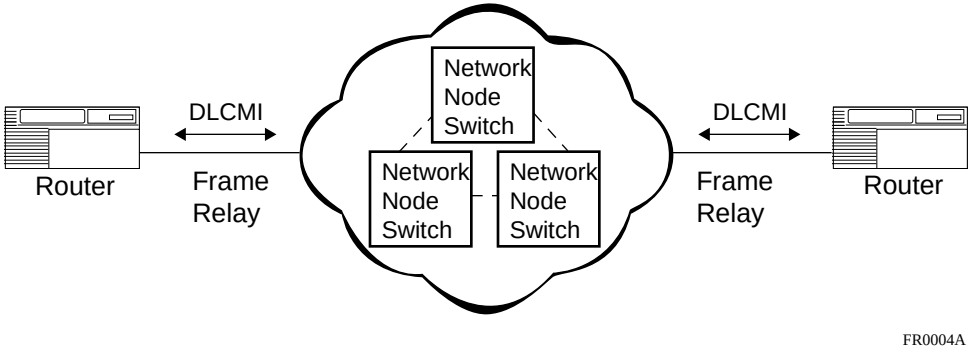

Figure 2-4. Conceptual Drawing of the DLCMI

DLCMI supports three standard data link management specifications: LMI, ANSI T1.617 Annex D, and CCITT (now ITU-T) Q.933 Annex A.

- The networking industry first developed the Local Management Interface (LMI) specification. The LMI approach is asymmetric; the router sends a status-enquiry message to the network, signaling that the router's connection to the network is functioning. The network replies with a status response.
- ANSI modified the LMI specification and incorporated it as Annex D to ANSI standard T1.617. The ANSI method is generally similar to the LMI approach.
- The CCITT (now ITU-T) modified the ANSI standard and adopted it as Annex A to Q.933. The CCITT Annex A specification is similar to Annex D, but it uses an international numbering scheme.

Be sure to configure the Frame Relay interface on the router to use the same management protocol as the switched network to which it is connected.
See Chapter 3 for information about configuring Frame Relay.

Frame Processing

When a frame enters a Frame Relay network, the network performs three steps to process the data:

1. Verifies the cyclic redundancy check (CRC); if an error is found, it drops the frame.
2. Performs a table lookup for the DLCI; if the DLCI is invalid or unknown, it drops the frame.
3. If the frame is valid, forwards it to its destination.

Frame Relay Service Records

Bay Networks uses *service records* to define Frame Relay circuits. A service record is a data structure that allows flexible grouping and characterization of PVCs. A service record can contain a single PVC or multiple PVCs.

Service records

- Support all protocols
- Simplify network addressing because you define and associate only one protocol address with groups of Frame Relay PVCs
- Allow multiple groups of PVCs per Frame Relay interface
- Enable you to group multiple PVCs for each network protocol into separate service records, thereby reducing the number of buffers needed per circuit during broadcasts
- Lower customer costs by creating multiple broadcast domains
- Conserve resources because they require a small number of circuits
- Are easy to configure

Default Service Record

The router creates the first service record automatically when you select Frame Relay as your WAN protocol. This first service record is the *default service record*. Any PVCs not associated with another configured service record use the default service record.

Multiple Service Records

Interfaces can have multiple service records, and each service record can contain multiple PVCs.

Adding and Moving PVCs

You can add PVCs to a service record either individually, or in a range. You can also move PVCs on the same interface from one service record to another individually or as a group. Refer to Chapter 3 for instructions.

Hybrid Mode

Frame Relay hybrid mode enables you to use the same PVCs for both routing and bridging. It works only for non-fully meshed network configurations that use

- Both bridging and routing over a single Frame Relay interface
- Spanning tree bridging

In a *fully meshed* network PVCs exist between each pair of nodes in the network. In a *non-fully meshed* network, PVCs exist only between nodes that need to communicate. Figure 2-5 shows a non-fully meshed network that uses hybrid mode.

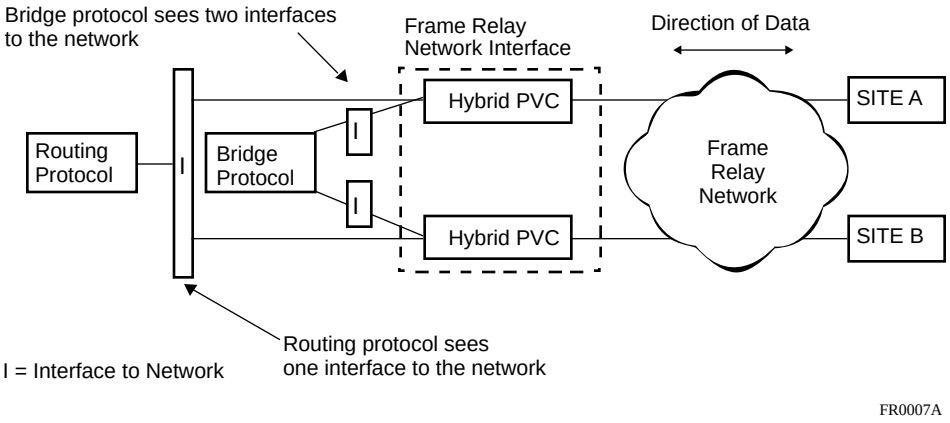

Figure 2-5. Hybrid Mode Configuration, Non-Fully-Meshed Network

Using Hybrid Mode for Transparent Bridging

Figure 2-6 shows bridged traffic between Site A and Site B. The bridge (Router 1) is running on the Frame Relay interface, and its configuration does not use hybrid mode.

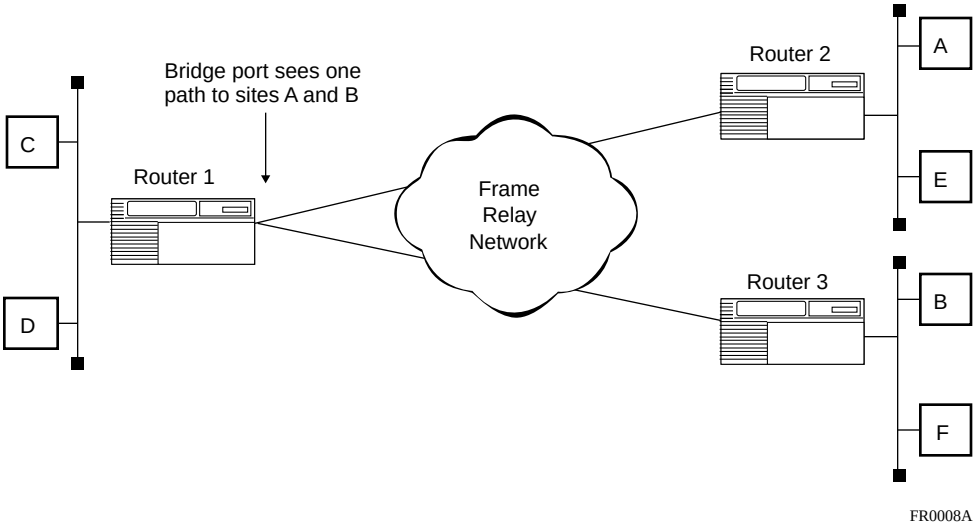

Figure 2-6. Example of a Bridged Network

In this example, the bridge receives data from Site A. If the bridge does not recognize the destination address, it tries to direct traffic through another bridge port. However, without hybrid access mode configured, the Frame Relay bridge port views the paths to Site A and Site B as the same path. Because the bridge does not send out data on the same port from which it just received data, the bridge does not direct the data to Site B. In this case, you should use hybrid access mode.

If you define the PVCs in hybrid mode (refer to Figure 2-5), each PVC acts as a separate bridge port. This enables the bridge running on the Frame Relay interface to view the traffic from Site A as arriving on a different port than that of Site B. When the bridge sends out data, it sends it out from all ports, including the port that has access to Site B. Therefore, data from Site A can reach Site B.

See Chapter 3 for instructions on setting the Hybrid Mode parameter.

Source Routing

Source routing is the method by which a bridge sends data across two networks. The router supports source routing over Frame Relay networks, using RFC 1490 standard Frame Relay data encapsulation or Bay Networks proprietary Frame Relay data encapsulation.

To configure source routing, refer to *Configuring Bridging Services*.

RFC 1490

RFC 1490 defines the encapsulation method for sending data across a Frame Relay network. Bay Networks routers implement RFC 1490 for all protocols that we support over Frame Relay networks.

Protocol Prioritization

You can set priorities for the traffic sent across a synchronous line interface using a process called *protocol prioritization*. The ability to prioritize traffic is important for an application that is time-sensitive and that requires a fast response.

Note: BNX software does not support protocol prioritization.

For example, a user at Router A participating in a TELNET session with Router B requires a more immediate response than does a user at Router A performing a file transfer with Router B.

When you select Frame Relay on a circuit, the router enables protocol prioritization automatically. It does so because the DLCMI packets must have a higher priority than any other packets you are sending across the network.

For more information about protocol prioritization, see *Configuring Traffic Filters and Protocol Prioritization.*

Address Resolution

Address resolution maps a remote network address such as an IP address to a local DLCI number. For most protocols that you configure for a Frame Relay interface, the router performs address resolution automatically. However, IP, AppleTalk, and VINES use the Address Resolution Protocol (ARP). ARP dynamically generates an ARP table of addresses and DLCI numbers by sending messages back and forth to each network node to gather address information. This process increases broadcast traffic across the network.

To reduce broadcast traffic for all protocols, you can configure static routes and adjacent hosts at the protocol level. This eliminates the need for the router to perform address resolution. To reduce traffic associated specifically with IP and VINES address resolution, you can configure Inverse ARP. Refer to the appropriate protocol manual for more information about static routes, adjacent hosts, and Inverse ARP.

Table 2-1 lists how the router handles address resolution for each protocol and whether or not you can reduce broadcast traffic by modifying the address resolution configuration.

Table 2-1. How Protocols Handle Address Resolution

Protocol	How Router Performs Address Resolution	Configuration Requirements
Bridge (including source route)	Automatic	None
IP	ARP or Inverse ARP	None for ARP Configure Inverse ARP
DECnet IV	Automatic	None
VINES	ARP or Inverse ARP	None for ARP Configure Inverse ARP
IPX	Automatic	None
XNS	Automatic	None
AppleTalk	AppleTalk ARP	None

Data Compression over Frame Relay

You can configure both hardware- and software-based data compression over WANs running Frame Relay.

Enabling compression improves bandwidth efficiency by eliminating redundant strings in data streams. This, in turn, improves network response times and reduces line costs.

To use data compression with Frame Relay, the Compression Control parameter must be set to Enable, the default value (refer to Chapter 3 or Appendix A for information about how to access this parameter). You must also select WCP (WAN Compression Protocol) from the protocols menu.

For a complete discussion of data compression, refer to *Configuring Data Compression Services*.

Multiline

Frame Relay provides a link redundancy feature called multiline. Multiline lets you group two or more physical lines that back each other up in case of a failure. This ensures that information arrives at its destination on the network. In addition, if both lines are up, the router uses both lines simultaneously. Two or more physical lines must be available for a multiline configuration. Figure 2-7 illustrates a multiline configuration.

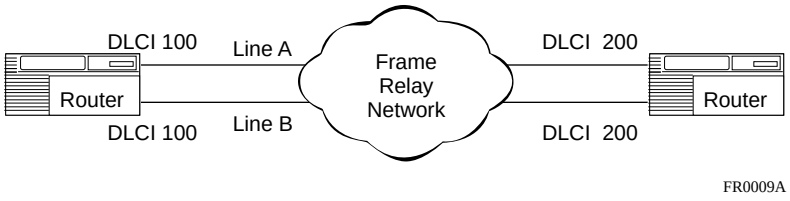

Figure 2-7. Multiline Network

In this example, when the router receives traffic destined for the network, it alternates randomly between Line A and Line B to transmit the data. The router uses both lines simultaneously to balance the traffic between each path. If one of these lines goes down, the router uses the remaining line.

You can multiline up to four service records. Each service record must be on a different physical line on the router. We also recommend that each line be on a different slot to provide fault tolerance.

You must also match DLCIs in each service record of the multiline. Matching DLCIs ensures that a backup exists for each PVC.

The most important part of configuring multiline is setting the PVC DLCI number. This number identifies each PVC, thereby specifying a path for the router to direct data to the network. For each Frame Relay PVC that you configure, be certain that PVCs with the same destination have the same DLCI number.

Note: If you use multiline, packets traveling on the two paths may arrive at their destination out of sequence. Some protocols do not tolerate packets arriving out of sequence and, as a result, you may experience poor performance or failures.

Refer to Chapter 3 for instructions about grouping service records for multiline.

Traffic Distribution between Data Paths

To distribute traffic between multiline data paths, you can use one of two methods:

- Random distribution
- Address-based distribution

Random Distribution

Random distribution means that as the router sends out each packet, it alternates between the lines. This option determines which line the packet uses based on a randomly assigned number. For each outbound packet, the router generates a random number, and this number designates the line to use.

Random balancing evenly distributes traffic and lets the router use the two lines efficiently. Because packets travel on different paths, they arrive at the destination out of sequence, and the upper-layer protocols, for example, IP and OSI, have to resequence the information. Some protocols cannot tolerate packets arriving out of sequence, so be sure this option is appropriate for your application.

Address-based Distribution

Address-based distribution, as the name implies, determines the data path for outbound traffic from the source and destination address in each packet. For any given address pair, the same path is always used.

The router determines whether to route or bridge the packet, and then uses the appropriate address. It uses the routing-level addresses for routing traffic, and the MAC-level addresses for bridging traffic.

Address-based distribution ensures that all outbound traffic travels on the same path, and that packets arrive in sequence. For protocols that cannot receive packets out of sequence, use this method. Note, however, that this option does not always distribute traffic evenly across each line.

Congestion Control

Network congestion can degrade network performance. Congestion occurs when a node receives more frames than it can process, or sends more frames than the transmission line can handle. The Frame Relay network informs the nodes of congestion, so that they can reduce the amount of traffic across the network.

In the Frame Relay packet header, there are two bits that the network sets to alert nodes of network congestion. These bits, as defined by the Frame Relay specification, are the FECN (forward explicit congestion notation) bit and the BECN (backward explicit congestion notation) bit.

If the network detects congestion, it alerts the router in the same direction as the received frame by changing the frame's FECN bit from 0 to 1. For nodes in the opposite direction of the received frame, it changes the frame's BECN bit from 0 to 1 (Figure 2-8).

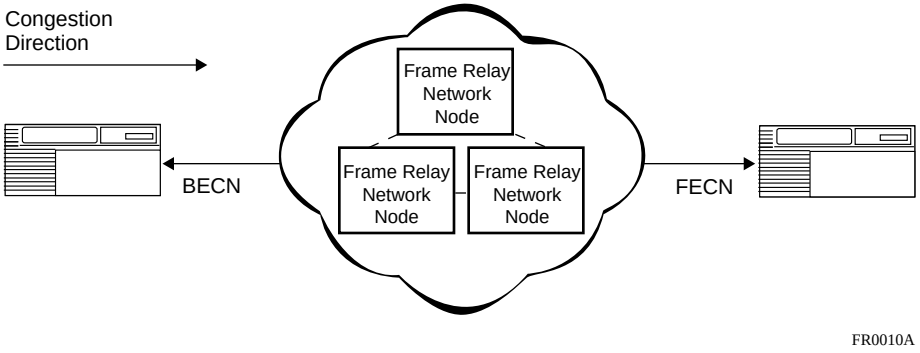

Figure 2-8. Detecting and Controlling Network Congestion

If you enable the congestion control feature, you can specify the number of FECN/BECN bits the router receives in a given time period before it stops transmitting frames. While frames are going across the network, the Frame Relay interface checks received packets for FECN and BECN bits set to 1. If the interface receives the specified number of bits during the designated time period, Frame Relay drops all traffic destined for the PVC where there is congestion. When the interface no longer receives these congestion notifications, the router resumes transmission.

For example, suppose you set the congestion timer to 0.5 seconds and the congestion count to 3. In this case, if an interface receives 3 FECNs or BECNs within 0.5 seconds, the node stops sending frames (although it continues to receive frames for this PVC). If the interface receives no FECNs or BECNs during the next 0.5 seconds, the router resumes transmission. Refer to Chapter 3 for instructions on configuring the congestion parameters.

Configuring Synchronous Lines for Frame Relay

If you enable Frame Relay on a circuit, Site Manager automatically sets the following synchronous line parameters (Table 2-2):

Table 2-2. Synchronous Line Parameters for Frame Relay

Parameter	Value
BOFL	Disable
Promiscuous	Enable
Service	Transparent
WAN Protocol	Frame Relay

For more information on these parameters, refer to *Configuring Line Services* or *Configuring Customer Access and Trunks (BNX Software)*, depending on the type of installed software.

For More Information about Frame Relay

For more information about Frame Relay, consult the following documents:

American National Standards Institute, T1.617-1991. *Integrated Services Digital Network (ISDN) – Digital Subscriber Signalling System No. 1 (DSS1) - Signalling Specification for Frame Relay Bearer Service*. Washington, D.C., June 1991.

-- T1.617 Annex D-1991. *Additional Procedures for Permanent Virtual Connections (PVCs) Using Unnumbered Information Frames*. Washington, D.C., June 1991.

-- T1.618-1991. *Integrated Services Digital Network (ISDN) - Core Aspects of Frame Protocol with Frame Relay Bearer Service.* Washington, D.C., June 1991.

Bradley, T.; Brown, C.; and Malis, A. *RFC 1490, Multiprotocol Interconnect over Frame Relay.* Menlo Park, California: Network Information Center (NIC), SRI International, January 1992.

Digital Equipment Corporation et al. *T1S1 - Standards based Frame Relay Specification with Common Enhancements.* Document Number 001-208966, Revision 1.0, September 1990.

The following publications provide a less technical introduction to Frame Relay:

Davidson, R. and Muller, N. *The Guide to SONET: Planning, Installing & Maintaining Broadband Networks.* New York: Telecom Library, Inc., 1991.

Goldstein, F. *ISDN in Perspective.* Reading, Massachusetts: Addison-Wesley Publishing Company, 1992.

Jennings, E.; Jones, T.; and Rehbehn, K. *The Buyer's Guide to Frame Relay Networking.* Netrix Corporation.

Chapter 3
Customizing Frame Relay

When you enable Frame Relay, default values are in effect for all parameters (see parameter descriptions in Appendix A). You may want to change these values, depending on your network requirements. The following sections describe choices you can make to use Frame Relay effectively on your network.

Using the MIB Object ID

The Technician Interface allows you to modify parameters by issuing **set** and **commit** commands with the MIB Object ID. This process is equivalent to modifying parameters using Site Manager. For more information about using the Technician Interface to access the MIB, refer to *Using Technician Interface Software*.

Caution: The Technician Interface does not verify parameter values you enter. Entering an invalid value can corrupt your configuration.

Adding and Deleting Service Records

A service record is a data structure that allows flexible grouping and characterization of PVCs. You can add and delete service records from your Frame Relay interfaces. When you add a new service record, it automatically has one PVC to which you must assign a DLCI number.

Site Manager Path: Select a port that you have configured for Frame Relay. The Edit Connector window appears. Select **Edit Circuit**. The Frame Relay Circuit Definition window appears. Select **Services**. The Frame Relay Service List window appears. Select **Add | Delete.**

If you want to delete a service record, select that service record and then select **Delete**. The service record no longer exists.

If you want to Add a service record, select **Add**. The Frame Relay Virtual Circuit window appears. Enter the DLCI number.

Site Manager: Service Name parameter: page A-8
Site Manager: DLCI Number parameter: page A-8

Adding and Deleting PVCs

You can add or delete PVCs from already existing service records. You can add PVCs either individually, or in a range. If you want to add one PVC, enter one DLCI number. If you want to add several PVCs, enter the appropriate range of DLCI numbers in the format

< lowest DLCI number> **-** *< highest DLCI number>*

Site Manager Path: Select a port that you have configured for Frame Relay. The Edit Connector window appears. Select **Edit Circuit**. The Frame Relay Circuit Definition window appears. Select **Services**. The Frame Relay Service List window appears. Select **PVCs**.

If you want to delete a PVC, select that PVC and then select **Delete**. The PVC no longer exists.

If you want to add a PVC, select Add > Frame Relay Virtual Circuit window and enter the DLCI number.

Site Manager: DLCI Number parameter: page A-8

Site Manager Path: Configuration Manager > Protocols > Frame Relay > Interfaces > Frame Relay Interface List window >**PVCS** > Frame Relay PVC List window. Select the PVC you want to delete. Click on Delete. Click on OK to delete the PVC.

After you delete a PVC, it may reappear on the list of active PVCs if the switch provider does not delete it. As soon as the switch provider removes the PVC, the Frame Relay dynamically deletes the PVC from the list.

If the switch provider deletes a PVC that you manually configured, the circuit state is set to Invalid, and the PVC remains unused until you delete it from the interface.

Moving PVCs from One Service Record to Another

You can move PVCs on the same line from one service record to another. You can move PVCs to already existing or to new service records.

Site Manager Path: Select a port that you have configured for Frame Relay. The Edit Connector window appears. Select **Edit Circuit**. The Frame Relay Circuit Definition window appears. Select **Services**. The Frame Relay Service List window appears. Select **Move.** The Frame Relay Service Record Selection window appears.

Site Manager: Service Name parameter: page A-8
Site Manager: DLCI Number parameter: page A-8

Configuring Hybrid Mode

Hybrid mode allows you to use the same PVCs for both routing and bridging. You configure hybrid mode by setting the Hybrid Mode parameter to ON. Refer to Chapter 2 for an explanation of hybrid mode.

Site Manager Path: Select a port that you have configured for Frame Relay. The Edit Connector window appears. Select **Edit Circuit**. The Frame Relay Circuit Definition window appears. Select **Services**. The Frame Relay Service List window appears. Select **Hybrid Mode** > ON

Site Manager: Hybrid Mode parameter: page A-9

Enabling Compression

To use data compression with Frame Relay, first select WCP from the Protocols menu, and make sure the Compression Control parameter is set to Enable.

Site Manager Path: Select a link or net module. Select **Frame Relay**. The Select Protocols window appears. Select **WCP**

Site Manager: Compression Control parameter: page A-11

Selecting a Management Type

You can specify the management protocol that the router and the Frame Relay network use to communicate status information. Routers connected back to back also use a management protocol to exchange status information. The following list describes your options:

- *DLCMI None* provides no management interface between the router and the Frame Relay network. In the absence of management support, you must configure all PVCs manually.
- *Rev 1 LMI* provides user-side management services as specified by Revision 1 of the Local Management Interface standard.
- *ANSI T1.617D* provides user-side management services as specified in Annex D to ANSI standard T1.617-1991. This is the default value.
- *CCITT Annex A* provides user-side management services as specified by the ITU-T (formerly CCITT).
- *LMI Switch* offers limited management services for the DCE side of the connection as specified by Revision 1 of the Local Management Interface standard.
- *Annex D Switch* provides limited management services for the DCE side of the connection as specified in Annex D to ANSI standard T1.617-1991.
- *Annex A Switch* provides limited management services for the DCE side of the connection as specified by the ITU-T.

If you are connecting two routers back to back, use one of the DTE parameter options (Rev 1 LMI, ANSI T1.617D, CCITT Annex A) for the router acting as a DTE, and one of the DCE options (LMI Switch, Annex D Switch, Annex A Switch) for the router acting as the DCE. Although you can configure the router for the DCE side of a connection, the router cannot act as a full switch, and it will not perform complete bidirectional signaling.

The LMI Switch, Annex D Switch, and Annex A Switch options are primarily for troubleshooting.

Site Manager: Mgmnt Type parameter: page A-2

Selecting Address Type and Length

You can specify the DLCI address type and length that the router and the Frame Relay network use to direct packets to their destinations. The address type for the router and for the switch must be the same.

Selecting a DLCI Address Type

Your options for the DLCI address type follow.

- *ADDR Q922* selects addressing as specified in the final version of the Q.922 standard. Q.922 provides for FECN, BECN, DE, and EA bits. While most Q.922 addresses are included within a 2-octet field, the standard allows for 3- and 4-octet address fields. This is the default.
- The *November draft of ADDR Q922* differs from ADDR Q922 in dropping the D/C bit from the extended (3- and 4-byte) forms. The D/C bit (DLCI or DL-Core Control Indication) is always 0.
- The *March draft of ADDR Q922* differs from ADDR Q922 in defining an 11-bit DLCI and dropping the DE bit from the second octet of the address field.
- *ADDR Q921* differs from ADDR Q922 MARCH 90 in that it does not use FECNs or BECNs, which means that it does not provide congestion control.

Site Manager: Address Type parameter: page A-3

Selecting Address Length

Your options for the DLCI address length are 2, 3, or 4 bytes. Refer to the illustrations of Frame Relay headers in Chapter 2 to understand the distinctions among these types.

Site Manager: Address Length parameter: page A-3

Monitoring the Connection

You can monitor the status of your Frame Relay network connection by setting

- Time intervals for the router to send messages that verify the integrity of the link
- The number and frequency of error messages that can occur before the connection terminates

The *polling interval* specifies the interval between status inquiry messages that the router transmits. Status inquiry messages cause a network response in the form of a link integrity verification message or full status message. Successful completion of the request/response “handshake” verifies the status of the router/Frame Relay network link. We recommend that you accept the default value, 10 seconds. If the default value does not match what the network requests, enter a value that is appropriate for your network in the range of 5 to 30 seconds. The polling interval does not function if you set the Mgmnt Type parameter to DLCMI None.

Site Manager: Polling Interval parameter: page A-4

The *full enquiry interval* specifies the interval between full status inquiry messages that the router transmits. Full status inquiry messages cause the network to send a full status report message, which lists all PVCs, PVC status (active or inactive), and whether each PVC is new or previously established.

The default value, 6, tells the router to send a full status inquiry every 6 polling intervals. For example, with a polling interval of 10 and a full enquiry interval of 6, the router transmits a full status inquiry every 60 seconds; with a polling interval of 20 and a full enquiry interval of 30, the router transmits a full status inquiry every 10 minutes (600 seconds). The full enquiry interval does not function if you set the Mgmnt Type parameter to DLCMI None.

Site Manager: Full Enquiry Interval parameter: page A-4

Error threshold and *monitored events* together establish a criterion to evaluate the quality of the router's Frame Relay network connection. The error threshold is the number of faulty status messages that must occur to terminate the connection. Monitored events is the number of status message exchanges, within which number those errors occur. For example, if you accept the default of 3 for the error threshold, and the default of 4 for monitored events, three status exchange errors in a sequence of four attempted exchanges brings the connection down. If you set error threshold to 5 and monitored events to 10, five status exchange errors in a continuous sequence of ten attempted exchanges brings the connection down.

Note: Error Threshold and Monitored Events do not function if you set Mgmnt Type to DLCMI None.

Site Manager: Error Threshold parameter: page A-5
Site Manager: Monitored Events parameter: page A-5

Enabling Multicast

The multicast feature sets up a separate DLCI that replicates broadcast packets and forwards them to the appropriate destinations. You can enable support for Frame Relay multicast service, but only if your Frame Relay subscription service provides multicast service.

Site Manager: Multicast parameter: page A-6, interface; page A-9, service record

Controlling Congestion

Congestion occurs when a node receives more frames than it can process, or sends more frames than the transmission line can transport. You can enable congestion control on your network. When you enable congestion control, the router receives congestion notification messages from the PVC experiencing congestion, and drops all outbound traffic destined for that PVC until it no longer receives congestion notifications.

Site Manager: Congestion Control parameter: page A-6, interface; page A-10, service record

When you enable congestion control, you can set the length of time during which the router counts congestion notifications. You can also set the maximum number of congestion notifications that the router can receive during this time period. If the router receives this number of congestion notifications within the time period you specify, it stops transmitting data. The router resumes transmission when it stops receiving congestion notifications.

If you enable congestion control, all PVCs on the interface use congestion control and the values you specify for the congestion timer and congestion counter, unless you configure PVCs individually and either disable this feature or select other values for the congestion control parameters.

Site Manager: Congestion Timer parameter: page A-7, interface; page A-10, service record

Site Manager: Congestion Counter parameter: page A-7, interface; page A-11, service record

Grouping Service Records for Multiline

You can configure two or more service records to run in multiline mode. Service records that you group for multiline must

- Reside on two separate physical ports
- Have the same DLCI numbers
- Not use hybrid mode

Refer to Chapter 2 for more information about multiline.

To group PVCs for multiline, complete the following steps:

Site Manager Path: Select a port that you have configured for Frame Relay. The Edit Connector window appears. Select **Edit Circuit**. The Frame Relay Circuit Definition window appears. Select **Services**. The Frame Relay Service List window appears. Select the PVC you want to multiline. Select **Multiline**. The Services Multilined with: *<line identifier>* window appears. Select **Add.** Select the PVC that you want to configure for multiline from the list in the window that appears.

Site Manager: Multiline Algorithm to Choose Line parameter: page A-12

Deleting Frame Relay from the Router

To delete Frame Relay from *all* circuits on which it is currently configured, complete the following steps.

Site Manager Path: Configuration Manager > Protocols > Frame Relay > Delete Frame Relay. A window appears and prompts: `Do you REALLY want to delete Frame Relay?` Click on OK. Site Manager returns you to the Configuration Manager window. Frame Relay is no longer operating on the platform.

Appendix A
Frame Relay Parameters

Interface Parameters

Parameter:	**Enable**
Path:	Configuration Manager > Protocols > Frame Relay > Interfaces
Default:	Enable
Options:	Enable | Disable
Function:	Enables or disables Frame Relay service on this port.
Instructions:	Set to Disable if you want to disable Frame Relay service on this interface without deleting it. Set to Enable to reenable Frame Relay service, if you previously disabled it.
MIB Object ID:	1.3.6.1.4.1.18.3.5.9.9.1.1.2

Parameter: Mgmnt Type

Path: Configuration Manager > Protocols > Frame Relay > Interfaces

Default: ANSI T1.617D

Options: DLCMI None | Rev 1 LMI | ANSI T1.617D | CCITT Annex A | LMI Switch | Annex D Switch | Annex A Switch

Function: Specifies the management protocol that the router and the Frame Relay network use to communicate status information. Routers connected back to back also use a management protocol to exchange status information.

DLCMI None provides no management interface between the router and the Frame Relay network. In the absence of management support, you must configure all PVCs manually.

Rev 1 LMI provides user-side management services as specified by Revision 1 of the Local Management Interface standard.

ANSI T1.617D provides user-side management services as specified in Annex D to ANSI standard T1.617-1991.

CCITT Annex A provides user-side management services as specified by the ITU-T (formerly CCITT).

LMI Switch offers limited management services for the DCE side of the connection as specified by Revision 1 of the Local Management Interface standard.

Annex D Switch provides limited management services for the DCE side of the connection as specified in Annex D to ANSI standard T1.617-1991.

Annex A Switch provides limited management services for the DCE side of the connection as specified by the ITU-T.

Instructions: Select the management protocol for the Frame Relay network. The LMI Switch, Annex D Switch, and Annex A Switch options are primarily for troubleshooting.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.1.1.6

Parameter: **Address Type**

Path: Configuration Manager > Protocols > Frame Relay > Interfaces

Default: ADDR Q922

Options: ADDR Q922 | ADDR Q922 November 90 | ADDR Q922 MARCH 90 | ADDR Q921

Function: Specifies the DLCI addressing type.

ADDR Q922 selects addressing as specified in the final version of the Q.922 standard. Q.922 provides for FECN, BECN, DE, and EA bits. While most Q.922 addresses are included within a 2-octet field, the standard allows for 3- and 4-octet address fields.

The November draft of ADDR Q922 differs from ADDR Q922 in dropping the D/C bit from the extended (3- and 4-byte) forms.

The March draft of ADDR Q922 differs from ADDR Q922 in defining an 11-bit DLCI and dropping the DE bit from the second octet of the address field.

ADDR Q921 differs from ADDR Q922 MARCH 90 in that it does not use FECNs or BECNs.

Instructions: Select the addressing type for the Frame Relay interface.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.1.1.8

Parameter: **Address Length**

Path: Configuration Manager > Protocols > Frame Relay > Interfaces

Default: Two Byte

Options: Two Byte | Three Byte | Four Byte

Function: Specifies the length of the Frame Relay address field.

The length of this field determines the range of valid numbers for the DLCI number set in the Frame Relay PVC List window. See the DLCI Number parameter description for more details.

Instructions: Select the address length for the address field. This must match what the network specifies.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.1.1.9

Parameter: Polling Interval

Path: Configuration Manager > Protocols > Frame Relay > Interfaces

Default: 10 seconds

Options: 5 through 30 seconds

Function: Specifies the interval between status inquiry messages that the router transmits. Status inquiry messages cause a network response in the form of a link Integrity verification message or full status message. Successful completion of the request/response “handshake” verifies the status of the router/Frame Relay network link.

Instructions: We recommend that you accept the default value, 10 seconds. If the default value does not match what the network requests, enter a value that is appropriate for your network in the range of 5 to 30 seconds. Polling Interval does not function if you set Mgmnt Type to DLCMI None.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.1.1.10

Parameter: Full Enquiry Interval

Path: Configuration Manager > Protocols > Frame Relay > Interfaces

Default: 6

Options: 1 through 255 polling intervals

Function: Specifies the interval between full status inquiry messages that the router transmits. Full status inquiry messages cause the network to send a full status report message, which lists all PVCs, the PVC status (active or inactive), and whether the PVC is new or previously established. This parameter works with the Polling Interval parameter.

The default value, 6, tells the router to send a full status inquiry every 6 polling intervals. For example, with a polling interval of 10 and a full enquiry interval of 6, the router transmits a full status inquiry every 60 seconds; with a polling interval of 20 and a full enquiry interval of 30, the router transmits a full status inquiry every 10 minutes (600 seconds).

Instructions: Enter a value from 1 through 255, according to what the network dictates. Full Enquiry Interval does not function if you set Mgmnt Type to DLCMI None.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.1.1.11

Parameter: Error Threshold

Path: Configuration Manager > Protocols > Frame Relay > Interfaces

Default: 3

Options: 0 through 2,147,483,647

Function: Together with the value of the Monitored Events parameter, establishes a criterion to evaluate the quality of the router/Frame Relay network connection.

If you accept the default values for both Error Threshold and Monitored Events, three status exchange errors in a sequence of four attempted exchanges will bring the connection down. With Error Threshold set to 5 and Monitored Events set to 10, five status exchange errors in a continuous sequence of ten attempted exchanges will bring the connection down.

After the network clears the connection, status exchanges continue, and the router monitors line integrity. When the number of consecutive, successful status exchanges is equal to the Error Threshold value, the router restores the Frame Relay connection.

Error Threshold and Monitored Events are nonfunctional if you set Mgmnt Type to DLCMI None.

Instructions: Enter the number of faulty status exchanges that will bring the connection down.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.1.1.1

Parameter: Monitored Events

Path: Configuration Manager > Protocols > Frame Relay > Interfaces

Default: 4

Options: 0 through 2,147,483,647

Function: Together with the value of the Error Threshold parameter, establishes a criterion o evaluate the quality of the router/Frame Relay network connection. Refer to the description of the Error Threshold parameter for more information.

Instructions: Enter the number of consecutive status exchanges you want the router to monitor.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.1.1.13

Parameter:	**Multicast**
Path:	Configuration Manager > Protocols > Frame Relay > Interfaces
Default:	Disable
Options:	Enable | Disable
Function:	Enables or disables support for Frame Relay multicast service.
Instructions:	Set to Enable if your Frame Relay subscription service provides multicast service, and if this Frame Relay interface should receive multicast messages.
MIB Object ID:	1.3.6.1.4.1.18.3.5.9.9.1.1.16

Parameter:	**Congestion Control**
Path:	Configuration Manager > Protocols > Frame Relay > Interfaces
Default:	Disable
Options:	Enable | Disable
Function:	Enables or disables congestion control on this interface.
Instructions:	Set to Enable to activate congestion control. This value tells the router to drop all outbound traffic destined for a PVC where congestion is occurring until the congestion clears. The value of this parameter affects all PVCs that you do not individually configure.
MIB Object ID:	1.3.6.1.4.1.18.3.5.9.9.1.1.22

Parameter: Congestion Timer

Path: Configuration Manager > Protocols > Frame Relay > Interfaces

Default: 1 second

Options: 0.5 through 5 seconds, in 0.5-second intervals

Function: Specifies the length of time during which the router counts congestion notifications. If the router receives the number of congestion notifications set by the congestion counter parameter, the router stops transmitting data. The router resumes transmission once it stops receiving congestion notifications.

Instructions: Set the length of time the router should count congestion notifications from the network. If you set this parameter for a long time period, the router may be less likely to stop transmission for an intermittent congestion condition. However, the router may be slow to detect congestion, resulting in long transmission delays once the congestion has cleared. The value of this parameter applies to all PVCs that you do not individually configure.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.1.1.23

Parameter: Congestion Counter

Path: Configuration Manager > Protocols > Frame Relay > Interfaces

Default: 20 notifications

Options: 1 through 500 notifications

Function: Indicates the maximum number of congestion notifications that the router can receive during the congestion timer period before it stops transmitting. If the router reaches the value set by this parameter, it determines the line is congested and stops transmitting.

Instructions: Specify the congestion count. The smaller the number, the more quickly the router detects congestion and stops transmitting. The value of this parameter applies to all PVCs that you do not individually configure.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.1.1.24

Service Record Parameters

Parameter: **Service Name**

Path: Configuration Manager (select a connector) > Edit Connector window > Edit Circuit > **Services** > Frame Relay Service List window

Default: None

Options: Variable length text string

Function: Identifies the service record.

Instructions: Each service record must have a unique name. The value of this parameter is supplied by your service provider. Change it only if you are certain that the new name you assign is unique in your network.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.5.1.7

Parameter: **DLCI Number**

Path: Configuration Manager (select a connector) > Edit Connector window > Edit Circuit > **Services** > Frame Relay Service List window > **Add**

Default: None

Options: The Frame Relay switch provider assigns DLCI numbers. These assigned numbers are valid options.

Valid DLCI numbers vary based on the Frame Relay address length. The DLCI numbers that the switch provider assigns are generally in the following ranges:

2 byte -- 16 through 1007
3 byte -- 1024 through 6451
4 byte -- 131072 through 8257535

Function: Specifies the PVC identification number that the Frame Relay network uses to direct data. If you are running IP over Frame Relay, the router uses this number as the MAC address for an adjacent host. Refer to *Configuring IP Services* for more information about adjacent hosts.

Instructions: Enter the decimal number that the Frame Relay provider assigns.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.2.1.4

Parameter: Circuit State Set

Path: Configuration Manager (select a connector) > Edit Connector window > Edit Circuit > **Services** > Frame Relay Service List window > **PVCs**

Default: Active

Options: Invalid | Active | Inactive

Function: Specifies the state of the PVC.

Instructions: Set to Active to indicate to a Frame Relay switch that the PVC is available for use. Set to Inactive to indicate that the PVC is configured, but not available for use, for example, before your switch provider actually activates the PVC. Choose Invalid if the PVC is configured, but the switch is unaware of it.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.2.1.7

Parameter: Multicast

Path: Configuration Manager (select a connector) > Edit Connector window > Edit Circuit > **Services** > Frame Relay Service List window > **PVCs**

Default: Unicast

Options: Unicast | Multicast

Function: Indicates whether this PVC is multicast or unicast.

Instructions: Set to unicast or multicast according to PVC type, as the Frame Relay switch provider instructs.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.2.1.19

Parameter: Hybrid Mode

Path: Configuration Manager (select a connector) > Edit Connector window > Edit Circuit > **Services** > Frame Relay Service List window > **PVCs**

Default: OFF

Options: ON | OFF

Function: Allows you to use the same PVC for both routing and bridging.

Instructions: Set to ON if you want to enable both routing and bridging services. If not, accept the default.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.1.2.1.24

Parameter: Congestion Control

Path: Configuration Manager (select a connector) > Edit Connector window > Edit Circuit > **Services** > Frame Relay Service List window > **PVCs**

Default: Inherit

Options: Disable | Enable | Inherit

Function: Enables or disables congestion control on this interface.

Instructions: Set to Enable to activate congestion control. This value tells the router to drop all traffic destined for a congested PVC until the congestion clears. Select Disable to deactivate congestion control. Accept the default, Inherit, if you want the Congestion Control setting for this PVC to match the setting you specify for the Frame Relay Interface Congestion Control parameter.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.2.1.25

Parameter: Congestion Timer

Path: Configuration Manager (select a connector) > Edit Connector window > Edit Circuit > **Services** > Frame Relay Service List window > **PVCs**

Default: 1 second

Options: 0.5 through 5 seconds, in 0.5-second intervals

Function: Specifies the length of time during which the router counts congestion notifications. If the router receives the number of congestion notifications set by the Congestion Counter parameter, the router stops transmitting data. The router resumes transmission once it stops receiving congestion notifications.

Instructions: Set the length of time the router should count congestion notifications from the network. If you set this parameter for a long time period, the router may be less likely to stop transmission for an intermittent congestion condition. However, the router may be slow to detect congestion, resulting in long transmission delays once the congestion has cleared.

If you set the Congestion Control parameter to Inherit, the PVC uses DLCMI for congestion control, not the value of this parameter.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.2.1.27

Parameter: Congestion Counter

Path: Configuration Manager (select a connector) > Edit Connector window > Edit Circuit > **Services** > Frame Relay Service List window > **PVCs**

Default: 20 notifications

Options: 1 through 500 notifications

Function: Sets the maximum number of congestion notifications that the router can receive during the Congestion Timer period before it stops transmitting.

Instructions: Specify the congestion count. The smaller the number, the more quickly the router detects congestion and stops transmitting. Note, however, that if you set the Congestion Control parameter to Inherit, the PVC uses DLCMI for congestion control, not the value of this parameter.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.2.1.28

Parameter: Compression Control

Path: Configuration Manager (select a connector) > Edit Connector window > Edit Circuit > **Services** > Frame Relay Service List window > **PVCs**

Default: Enable

Options: Enable | Disable

Function: Enables or disables data compression for this service record.

Instructions: Accept the default, Enable, or select Disable if you decide not to use data compression for this service record.

MIB Object ID: 1.3.6.1.4.1.18.3.5.9.9.2.1.29

Multiline Parameter

Parameter:	**Multiline Algorithm to Choose Line**
Path:	Configuration Manager (select a connector) > Edit Connector window > Edit Circuit > **Services** > Frame Relay Service List window > **Multiline**
Default:	None
Options:	Random | Address Based
Function:	Specifies how the multiline circuit distributes traffic over its data paths.
Instructions:	Select Random to send data alternately over the two paths. This method ensures even distribution among the lines, but the packets arrive out of sequence. Select Address Based if the traffic between the same source and destination address pair is always going over the same data path. This method ensures the data arrives in sequence.
MIB Object ID:	`1.3.6.1.4.1.18.3.5.1.4.1.1.23`

Appendix B
Frame Relay Default Settings

This appendix lists the default parameter settings for Frame Relay. Use the Configuration Manager to edit any of the default settings listed here.

Table B-1. Frame Relay Interface Parameters

Parameter	Default
Enable	Enable
Mgmnt Type	ANSI T1.617D
Address	Addr Q922
Address Length	Two Byte
Polling Interval	10 seconds
Full Enquiry Interval	6
Error Threshold	3
Monitored Events	4
Multicast	Disable
Congestion Control	Disable
Congestion Timer	1 second
Congestion Counter	20 notifications

Table B-2. Frame Relay Service Record Parameters

Parameter	Default
Service Name	None
DLCI Number	None
Circuit State Set	Active
Multicast	Unicast
Hybrid Mode	OFF
Congestion Control	Inherit
Congestion Timer	1 second
Congestion Counter	20 notifications
Compression Control	Enable

Table B-3. Multiline Parameter

Parameter	Default
Multiline Algorithm to Choose Line	None

Index

A

adding
  PVCs, 3-2
  service records, 3-2
adding PVCs to a service record, 2-6
address resolution, 2-10
address-based distribution for multiline, 2-12

B

backward explicit congestion notification (BECN)
  definition of, 2-2
  congestion control, 2-13
Bay Networks
  CompuServe forum, xx
  Customer Service FTP, xix
  home page on World Wide Web, xix
  InfoFACTS service, xxi
  publications, ordering, xvi
  support programs, xviii
  Support Source CD, xx
  Technical Response Center, xvii, xxi
  technical support, xvii

C

CompuServe, Bay Networks forum on, xx
congestion of network, 2-13
Customer Service FTP, xix
customer support. *See* getting help
Customizing Frame Relay, 3-1

D

data compression, 2-11, 3-4
data link control identifier (DLCI), 2-2
Data Link Control Management Interface (DLCMI)
  definition of, 2-4
  standards of, 2-4
default parameter values, B-13
default service record, 2-5
deleting
  Frame Relay, 3-9
  PVCs, 3-2
  service records, 3-2
deleting Frame Relay, 1-2

E

enabling Frame Relay, 1-1

F

forward explicit congestion notification (FECN)
  congestion control, 2-13
  definition of, 2-2
frame processing, 2-5
Frame Relay
  defaults, B-13
  deleting from a router, 1-2
  overview, 2-1
  reference sources, 2-15
  starting, 1-1

G

getting help
from a Bay Networks Technical Response Center, xxi
from the Support Source CD, xx
through CompuServe, xx
through Customer Service FTP, xix
through InfoFACTS service, xxi
through World Wide Web, xix
grouping service records for multiline, 3-9

H

header format
2-byte, 2-3
3- or 4-byte, 2-3
hybrid mode, 2-6 to 2-8, 3-3

I

InfoFACTS service, xxi

L

LMI (Local Management Interface), 2-4, 3-4, A-2

M

management protocols. *See* Data Link Control Management Interface (DLCMI)
management type, selecting, 3-4
moving PVCs, 3-3
moving PVCs from one to another service record, 2-6
multiline
configuring, 3-9
description of, 2-11
traffic distribution over lines, 2-12

N

network congestion, 2-13

O

overview of Frame Relay, 2-1 to 2-16

P

packet structure of Frame Relay packet, 2-2
protocol prioritization, 2-9
PVCs
adding, 3-2
definition of, 2-1
deleting, 3-2
moving, 3-3

R

random traffic distribution for multiline, 2-12
RFC 1490, 2-9

S

service records
adding, 3-2
default service record, 2-5
deleting, 3-2
multiple, on an interface, 2-6
source routing using RFC 1490, 2-9
starting Frame Relay, 1-1
Support Source CD, xx
synchronous line configuration, 2-15

T

traffic distribution for multiline, 2-12

V

virtual circuits for connections, 2-1

W

World Wide Web, Bay Networks home page on, xix